

What is claimed is:

1. A process for the manufacture of 1,1,3,3,3-pentafluoropropene comprising reacting a reactant comprising at least one of 1-chloro-1,1,3,3,3-pentafluoropropane and 1,1,1,3,3,3-hexafluoropropane, with a caustic under conditions sufficient to dehydrochlorinate 1-chloro-1,1,3,3,3-pentafluoropropane and/or to dehydrofluorinate 1,1,1,3,3,3-hexafluoropropane, to form a reaction product which comprises 1,1,3,3,3-pentafluoropropene.
- 5 2. The process of claim 1 further comprising the subsequent step of purifying the resulting 1,1,3,3,3-pentafluoropropene.
- 10 3. The process of claim 1 further comprising the subsequent step of purifying the resulting 1,1,3,3,3-pentafluoropropene by washing with a caustic solution, drying and distilling.
- 15 4. The process of claim 1 wherein the reactant comprises 1-chloro-1,1,3,3,3-pentafluoropropane.
- 20 5. The process of claim 1 wherein the reactant comprises 1,1,1,3,3,3-hexafluoropropane.
6. The process of claim 1 wherein the reactant comprises both 1-chloro-1,1,3,3,3-pentafluoropropane and 1,1,1,3,3,3-hexafluoropropane.
- 25 7. The process of claim 1 wherein said caustic solution comprises NaOH, KOH, Ca(OH)₂, CaO or combinations thereof.

8. The process of claim 1 wherein said dehydrochlorination of 1-chloro-1,1,3,3,3-pentafluoropropane and said dehydrofluorination of 1,1,1,3,3,3-hexafluoropropane are conducted simultaneously in the same reactor.

5 9. The process of claim 1 wherein the reaction is conducted at a temperature of from about 20°C to about 150°C.

10 10. The process of claim 1 wherein the reaction is conducted at atmospheric pressure, superatmospheric pressure or under vacuum.

10 11. The process of claim 1 wherein the caustic strength of said caustic is from about 2 wt % to about 100 wt % optionally in water.

15 12. The process of claim 1 wherein the 1-chloro-1,1,3,3,3-pentafluoropropane and/or 1,1,1,3,3,3-hexafluoropropane are previously prepared by fluorinating 1,1,1,3,3,3-hexachloropropane with hydrogen fluoride in a vapor phase in the presence of a fluorination catalyst.

20 13. The process of claim 12 wherein said fluorination catalyst is selected from the group consisting of transition metal halides, Group IVb metal halides, Group Vb metal halides and combinations thereof on activated carbon or fluorinated alumina.

25 14. The process of claim 12 wherein said fluorination catalyst is selected from the group consisting of $SbCl_5$, $SbCl_3$, SbF_5 , $TaCl_5$, $SnCl_4$, $NbCl_5$, $TiCl_4$, $MoCl_5$, Cr_2O_3 , Cr_2O_3/Al_2O_3 , Cr_2O_3/AlF_3 , Cr_2O_3 /carbon, $CoCl_2/Cr_2O_3/Al_2O_3$, $NiCl_2/Cr_2O_3/Al_2O_3$, $CoCl_2/AlF_3$, $NiCl_2/AlF_3$ and combinations thereof.

15. The process of claim 12 wherein said fluorination catalyst is selected from the group consisting of Cr_2O_3 , $\text{Cr}_2\text{O}_3/\text{carbon}$, $\text{Cr}_2\text{O}_3/\text{AlF}_3$, $\text{CoCl}_2/\text{AlF}_3$, $\text{NiCl}_2/\text{AlF}_3$ and combinations thereof.

5 16. The process of claim 12 wherein said fluorination catalyst comprises SbCl_3 or SbCl_5 supported on activated carbon.

10 17. The process of claim 1 wherein the 1-chloro-1,1,3,3,3-pentafluoropropane and/or 1,1,1,3,3,3-hexafluoropropane are previously prepared by fluorinating 1,1,1,3,3,3-hexachloropropane with hydrogen fluoride in a liquid phase in the presence of a fluorination catalyst.

15 18. The process of claim 17 wherein said fluorination catalyst is selected from the group consisting of transition metal halides, Group IVb metal halides, Group Vb metal halides and combinations thereof.

20 19. The process of claim 17 wherein said fluorination catalyst is selected from the group consisting of SbCl_5 , SbCl_3 , SbF_5 , TaCl_5 , SnCl_4 , NbCl_5 , TiCl_4 , MoCl_5 , and combinations thereof.

20 20. The process of claim 17 wherein said fluorination catalyst is selected from the group consisting of SbCl_5 , SbCl_3 and combinations thereof.

25 21. The process of claim 12 wherein the fluorination is conducted at a temperature of from about 80°C to about 400°C.

22. The process of claim 12 wherein the fluorination is conducted at atmospheric pressure, superatmospheric pressure or under vacuum.

23. The process of claim 12 wherein the mole ratio of hydrogen fluoride to 5 1,1,1,3,3,3-hexachloropropane is from about 2:1 to about 100:1.

24. The process of claim 12 further comprising feeding chlorine to the fluorination reaction to keep the fluorination catalyst active.

10 25. The process of claim 17 wherein the fluorinating is conducted at a temperature of from about 65°C to about 150°C.

26. The process of claim 17 wherein the fluorinating is conducted at a pressure of from about 50 psig and 400 psig.

15 27. The process of claim 17 wherein the fluorinating is conducted at a pressure of from about 60 psig to about 200 psig.

28. The process of claim 17 wherein the mole ratio of hydrogen fluoride to 1,1,1,3,3,3-hexachloropropane is from about 2:1 to about 100:1.

20 29. The process of claim 17 wherein the mole ratio of hydrogen fluoride to 1,1,1,3,3,3-hexachloropropane is from about 6:1 to about 20:1.

25 30. The process of claim 17 further comprising feeding chlorine to the fluorination reaction to keep the fluorination catalyst active.

31. The process of claim 30 wherein the chlorine is fed to the fluorination reaction in an amount of from about 0.1 mol% to about 10 mol% based on the sum of the quantity of 1,1,1,3,3,3-hexachloropropane and recycled intermediates

5 32. A process for the manufacture of 1,1,3,3,3-pentafluoropropene comprising thermally decomposing a reactant comprising at least one of 1-chloro-1,1,3,3,3-pentafluoropropane and 1,1,1,3,3,3-hexafluoropropane, under conditions sufficient to dehydrochlorinate 1-chloro-1,1,3,3,3-pentafluoropropane and/or to dehydrofluorinate 1,1,1,3,3,3-hexafluoropropane, to form a reaction product which

10 comprises 1,1,3,3,3-pentafluoropropene and wherein the decomposing is conducted either without a catalyst or with a catalyst selected from the group consisting of transition metal halides and oxides and combinations thereof.

15 33. The process of claim 32, the catalyst is selected from, a group consisting of iron halides, nickel halides, cobalt halides and combinations thereof.

20 34. The process of claim 32 wherein 1-chloro-1,1,3,3,3-pentafluoropropane is dehydrochlorinated to form a reaction product which comprises 1,1,3,3,3-pentafluoropropene.

25 35. The process of claim 32 wherein 1,1,3,3,3-hexafluoropropane is dehydrofluorinated to form a reaction product which comprises 1,1,3,3,3-pentafluoropropene.

36. The process of claim 32 wherein both 1-chloro-1,1,3,3,3-pentafluoropropane is dehydrochlorinated and 1,1,1,3,3,3-hexafluoropropane is dehydrofluorinated to form a reaction product which comprises 1,1,3,3,3-pentafluoropropene.

37. The process of claim 35 wherein said dehydrochlorination of 1-chloro-1,3,3,3-tetrafluoropropane and said dehydrofluorination of 1,1,1,3,3,3-hexafluoropropane are conducted simultaneously in the same reactor.

5 38. The process of claim 32 which is conducted at a temperature of from about 30°C to about 400°C.

39. The process of claim 32 which is conducted at a temperature of from about 50°C to about 350°C.

10 40. The process of claim 32 which is conducted at a temperature of from about 75°C to about 300°C.

41. The process of claim 32 which is conducted at atmospheric pressure, superatmospheric pressure or under vacuum.

15 42. The process of claim 32 which is conducted in the presence of the catalyst.

43. The process of claim 42 wherein the catalyst is selected from the group consisting of supported or bulk transition metal halides and oxides and combinations thereof.

20 44. The process of claim 42 wherein said catalyst comprises supported or bulk FeCl_2 , FeCl_3 , NiCl_2 or CoCl_2 .

25 45. The process of claim 32 wherein the 1-chloro-1,1,3,3,3-pentafluoropropane and/or 1,1,1,3,3,3-hexafluoropropane are previously prepared by fluorinating

1,1,1,3,3-hexachloropropane with hydrogen fluoride in the vapor phase in the presence of a fluorination catalyst.

46. The process of claim 45 wherein said fluorination catalyst is selected from the
5 group consisting of transition metal halides, Group IVb metal halides, Group Vb metal halides and combinations thereof on activated carbon or fluorinated alumina.

47. The process of claim 45 wherein said fluorination catalyst is selected from the group consisting of $SbCl_5$, $SbCl_3$, SbF_5 , $TaCl_5$, $SnCl_4$, $NbCl_5$, $TiCl_4$, $MoCl_5$, Cr_2O_3 ,
10 Cr_2O_3/Al_2O_3 , Cr_2O_3/AlF_3 , Cr_2O_3 /carbon, $CoCl_2/Cr_2O_3/Al_2O_3$, $NiCl_2/Cr_2O_3/Al_2O_3$, $CoCl_2/AlF_3$, $NiCl_2/AlF_3$ and combinations thereof.

48. The process of claim 45 wherein said fluorination catalyst is selected from the group consisting of Cr_2O_3 , Cr_2O_3 /carbon, Cr_2O_3/AlF_3 , $CoCl_2/AlF_3$, $NiCl_2/AlF_3$ and combinations thereof.
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49. The process of claim 45 wherein said fluorination catalyst comprises $SbCl_3$ or $SbCl_5$ supported on activated carbon.
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50. The process of claim 45 wherein the fluorinating is conducted at a temperature of from about 0°C to about 400°C.

51. The process of claim 45 wherein the fluorinating is conducted at a temperature of from about 200°C to about 330°C.
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52. The process of claim 45 wherein the fluorinating is conducted at superatmospheric, atmospheric pressures or under vacuum.

53. The process of claim 45 wherein the fluorinating is conducted at a pressure of from about 50 psig to about 200 psig.

5 54. The process of claim 45 wherein the mole ratio of hydrogen fluoride to 1,1,1,3,3,3-hexachloropropane is from about 2:1 to about 100:1.

10 55. The process of claim 45 wherein the mole ratio of hydrogen fluoride to 1,1,1,3,3,3-hexachloropropane is from about 6:1 to about 20:1.

15 56. The process of claim 45 further comprising feeding chlorine to the fluorinating reaction to keep the fluorination catalyst active.

20 57. The process of claim 32 wherein the 1-chloro-1,1,3,3,3-pentafluoropropane and/or 1,1,1,3,3,3-hexafluoropropane are previously prepared by fluorinating 1,1,1,3,3,3-hexachloropropane with hydrogen fluoride in a liquid phase in the presence of a fluorination catalyst.

25 58. The process of claim 57 wherein hydrogen fluoride resulting from the dehydrofluorination of 1,1,1,3,3,3-hexafluoropropane is recycled to the reaction of fluorinating 1,1,1,3,3,3-hexachloropropane.

59. The process of claim 57 wherein said fluorination catalyst is selected from the group consisting of transition metal halides, Group IVb metal halides, Group Vb metal halides and combinations thereof.

60. The process of claim 57 wherein said fluorination catalyst is selected from the group consisting of $SbCl_5$, $SbCl_3$, SbF_5 , $TaCl_5$, $SnCl_4$, $NbCl_5$, $TiCl_4$, $MoCl_5$, and combinations thereof.

5 61. The process of claim 57 wherein said fluorination catalyst is selected from the group consisting of $SbCl_5$, $SbCl_3$ and combinations thereof.

62. The process of claim 57 wherein the fluorinating is conducted at a temperature of from about 50°C to about 4500°C.

10 63. The process of claim 57 wherein the fluorinating is conducted at a temperature of from about 65°C to about 150°C.

64. The process of claim 57 wherein the fluorinating is conducted at a pressure of from about 50 psig and 400 psig.

15 65. The process of claim 57 wherein the fluorinating is conducted at a pressure of from about 60 psig and 200 psig.

20 66. The process of claim 57 wherein the mole ratio of hydrogen fluoride to 1,1,1,3,3,3-hexachloropropane is from about 2:1 to about 100:1.

67. The process of claim 57 wherein the mole ratio of hydrogen fluoride to 1,1,1,3,3,3-hexachloropropane is from about 6:1 to about 20:1.

25 68. The process of claim 57 further comprising feeding chlorine to the fluorinating reaction to keep the fluorination catalyst active.